MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
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Gaithersburg, Maryland 20899-2320

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SRM Number: 3123a
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SRM Name: Holmium Standard Solution

Date of Issue: 30 May 2006

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of holmium. One unit of SRM 3123a consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of holmium. The solution contains nitric acid at a volume fraction of approximately 10 %.

Material Name: Holmium Standard Solution

Other Designations:

Holmium: Ho; elemental holmium
Holmium Nitrate: Holmium trinitrate; nitric acid, holmium(3+) salt; holmium(+3) cation trinitrate
Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Holmium Nitrate	10168-82-8	233-438-8	2.13
Holmium	7440-60-0	231-169-0	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Holmium nitrate can also cause severe illness or irritation. The toxicity of elemental holmium is low.

Physical Hazards: Glass container may break or shatter.

Potential Health Effects

Inhalation: Nitric acid can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Teeth may also be damaged. Inhalation of holmium or holmium nitrate may irritate the mucous membranes and respiratory tract, and may also cause itching, sensitivity to heat, and an increased awareness of odor and taste. Chemical pneumonia may result.

Skin Contact: Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Skin contact with holmium nitrate may cause skin irritation with hair loss. Elemental holmium causes only slight irritation and is unlikely to be absorbed through the skin.

Eye Contact: Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Holmium nitrate also causes severe eye irritation that may result in conjunctivitis. Holmium powder may cause slight mechanical irritation.

Ingestion: Nitric acid can cause severe burns and damage to the GI tract. Ingestion of holmium nitrate may cause nausea, vomiting, diarrhea, bluish-purple discoloration of the skin, and possible damage to the esophagus and liver; like other rare earth compounds, it may also interfere with blood clotting. Elemental holmium has low oral toxicity, but ingestion should be avoided.

Medical Conditions Aggravated by Exposure: None documented for this mixture. Its components may aggravate disorders of the eyes, skin, respiratory tract, kidneys, nervous system, cardiovascular system, and/or blood.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. Fire Fighting Measures

Fire and Explosion Hazards: Nitric acid is a powerful oxidizing agent that can react with combustible materials to cause fires. Holmium nitrate is also a fire and explosion hazard with combustible materials, and it can combine with cyanides to cause a violent explosion. Holmium in bulk form is a negligible fire hazard, but dust, powder, or fumes are flammable and explosive when exposed to heat or flames. No data are available for the mixture, and its behavior may differ from that of the individual components.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. Accidental Release Measures

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. Handling and Storage

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials. Use opened containers immediately or discard.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). If contact with this material occurs, wash hands or change clothing as required. Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. Exposure Controls and Personal Protection

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m^3

OSHA TLV-TWA: 2 ppm or 5 mg/m^3

UK WEL: 5.2 mg/m^3

Holmium Nitrate:

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m^3; respirable dust, 5 mg/m^3

ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m^3; respirable dust, 3 mg/m^3

UK WEL: None established. Total inhalable dust, 10 mg/m^3; respirable dust, 4 mg/m^3

Holmium:

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m^3; respirable dust, 5 mg/m^3

ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m^3; respirable dust, 3 mg/m^3

UK WEL: None established. Total inhalable dust, 10 mg/m^3; respirable dust, 4 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	**Holmium Nitrate**	**Holmium**
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** White or orange crystalline solid, slightly hygroscopic; no odor.	**Appearance and Odor:** A soft, silvery-gray metallic solid or powder. No odor.
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 350.96 (anhydrous)	**Relative Molecular Weight:** 164.93
Molecular Formula: HNO_3	**Molecular Formula:** $Ho(NO_3)_3$	**Molecular Formula:** Ho
Specific Gravity: 1.0543 (10%)	**Specific Gravity: N/A**	**Specific Gravity:** 8.795
Solvent Solubility: Decomposes in alcohol	**Solvent Solubility:** Soluble in strong mineral acids	**Solvent Solubility:** Soluble in dilute acids
Water Solubility: Soluble	**Water Solubility:** Soluble	**Water Solubility:** Reacts with water
Boiling Point (ºC): 86 (187°F)	**Boiling Point:** N/A	**Boiling Point:** 2695 (4883ºF)
Vapor Pressure (Pa): 946 @20°C	**Vapor Pressure (Pa):** N/A	**Vapor Pressure (Pa):** N/A
Vapor Density (Air=1): 2.17	**Vapor Density (Air=1):** N/A	**Vapor Density (Air=1):** N/A
pH: 1.0 (0.1M solution)	**pH:** 3 (20% solution)	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this solution do not exist. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Contact with incompatible materials; dust generation; electric arcs, open flames, or sparks; moisture.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Holmium Nitrate: Combustible materials and cyanides (fire or explosion hazard); strong bases.

Holmium: Air, strong acids, strong oxidizing agents, acid chlorides, halogens, chlorates, bromates, iodates.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of this material may produce nitrogen oxides (NO, NO_2, and N_2O) and irritating fumes.

Hazardous Polymerization: ____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg
Rat, oral: LD_{50} > 90 mg/kg
Rat, inhalation: LC_{50} (4 hrs) = 130 mg/m^3

Holmium Nitrate:

Rat, oral: LD_{50} = 2313 mg/kg
Rat, intraperitoneal: LD_{50} = 208 mg/kg
Mouse, intraperitoneal: LD_{50} = 247 mg/kg

Holmium: No acute toxicity data found for elemental Ho.

Target Organ(s): Skin, eyes, respiratory tract, GI tract, central nervous system, blood, kidneys.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has also been investigated as a possible mutagen. Holmium and its compounds are not classified as mutagens or teratogens.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC_{50} (48 hrs) = 180,000 µg/L
Starfish (*Asterias rubens*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Hooknose (*Agonus cataphractus*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L
Cockle (*Cerastoderma edule*): LC_{50} (48 hrs) = 330,000 to 1,000,000 µg/L

Holmium Nitrate: No ecotoxicity data were found.

Holmium: No ecotoxicity data were found.

Environmental Summary: The ecological effects of this mixture have not been fully evaluated. Do not release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lb.
Holmium Nitrate: Not regulated
Holmium: Not regulated

SARA Title III Section 302: Nitric acid is regulated

SARA Title III Section 304: Nitric acid is regulated

SARA Title III Section 313: Nitric acid and holmium nitrate (N511, Nitrate Compounds) are regulated.

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq$ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	Yes
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: No components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Holmium Nitrate: C (oxidizing material)
Holmium: D2B (toxic material)

WHMIS Ingredient Disclosure List: Nitric acid is regulated.

CEPA Domestic Substances List (DSL): Nitric acid is regulated.

CEPA Non-Domestic Substances List (NDSL): Holmium and holmium nitrate are regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)
Holmium Nitrate: Xn (Harmful); not classified in Annex I of Directive 67/548/EEC; not on a priority list.
Holmium: Xn (Harmful); not classified in Annex I of Directive 67/548/EEC; not on a priority list.

Risk Phrases (mixture):

R23 (toxic by inhalation)
R25 (toxic if swallowed)
R34 (causes burns)
R36/37/38 (irritating to eyes, respiratory system and skin)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

Haley TJ, Pharmacology and toxicology of the rare earth elements. *Journal of Pharmaceutical Sciences* 1965;54(5):663-670.

PAN Pesticide Database: Nitric Acid.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, September 2005 edition. DHHS (NIOSH) Publication No. 2005-151.